



Europäisches Patentamt
European Patent Office
Office européen des brevets



Publication number: **0 300 063 B1**

(12)

EUROPEAN PATENT SPECIFICATION

- (43) Date of publication of patent specification: **04.03.92** (51) Int. Cl.⁵: **H02K 9/06, H02K 19/36, H02K 11/00**
- (21) Application number: **84114880.2**
- (22) Date of filing: **12.12.80**
- (10) Publication number of the earlier application in accordance with Art.76 EPC: **0 030 725**

(54) **An alternative current generator with a voltage regulator unit for use in vehicles.**

(30) Priority: **14.12.79 JP 162439/79**

(43) Date of publication of application:
25.01.89 Bulletin 89/04

(43) Publication of the grant of the patent:
04.03.92 Bulletin 92/10

(86) Designated Contracting States:
DE FR GB IT

(56) References cited:
CH-A- 441 492
DE-A- 1 613 189
US-A- 3 198 972
US-A- 3 253 167

(73) Proprietor: **NIPPONDENSO CO., LTD.**
1-1, Showa-cho
Kariya-shi Aichi-ken(JP)

(72) Inventor: **Nimura, Takayasu**
1-4, Horagai Midori-ku
Nagoya-shi Aichi-ken(JP)
Inventor: **Shiga, Tsutomu**
320, Aza Kamiyama Ooaza Kouriki
Kouda-cho Nukata-gun Aichi-ken(JP)

(74) Representative: **Klingseisen, Franz, Dipl.-Ing.**
et al
Dr. F. Zumstein sen. Dr. E. Assmann Dr. F.
Zumstein jun. Dipl.-Ing. F. Klingseisen
Bräuhausstrasse 4
W-8000 München 2(DE)

EP 0 300 063 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid (Art. 99(1) European patent convention).

Rank Xerox (UK) Business Services

Description

The invention relates to an alternate current generator according to the preamble of claim 1.

Such an alternate current generator is disclosed in US-A 3 198 972. The housing of this known structure comprises a tubular portion between the two frame pieces. Slip rings are arranged inside of said housing so that one bearing has a certain distance from the adjacent pole core.

GB-A 1 149 856 discloses an alternator the housing of which consists of a pressed shell on an end bracket. Slip rings are provided on the shaft outside of this housing. One fan is arranged inside of the housing and another fan is provided outside of the housing on the opposite side.

The rotational speed of an alternate current generator used in vehicles can be increased by using a poly V belt as the driving means. In order to realize such a high speed alternate current generator, it is necessary to make the structure of the generator firm so as to reduce flexion of the axis of the generator, to reduce vibrations of the generator, to give the generator an excellent centrifugal force characteristic, and hence to make the generator competent to withstand the high speed rotation. Also, it is necessary to provide an excellent cooling system in which stator windings, rectifiers, a regulator of the integral circuit type, rotor winding and bearings can be cooled in a suitable manner. Further, it is necessary to reduce the noise of the generator when rotating, which noise arises from the friction between the blades of the cooling fan in the generator and the air.

The present invention is directed to improve the structure of the alternate current generator so as to comply with the above described requirements for the high speed rotation of the alternate current generator.

It is the main object of the invention to create a high speed alternate current generator which has increased structure strength and exerts reduced vibration.

This object is solved according to the invention by the features in the characterizing part of claim 1.

Fig. 1 illustrates an elevational view of the alternate current generator as an embodiment of the present invention.

Fig. 2 illustrates a side view of the alternate current generator of Fig. 1 in which the rear cover is removed, and

Fig. 3 is a cross-sectional view of the alternate current generator of Fig. 2 as an embodiment of the present invention, taken along line III-III.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The structure of the alternate current generator in accordance with an embodiment of the present invention is illustrated in Figs. 1, 2 and 3. The housing of the generator consists of a pair of frame pieces 1 and 1' which directly connect with each other at their circular edges to form an area to accommodate the operative members of the alternate current generator. The frame pieces 1 and 1' are fixed to each other by through bolts only one of which is illustrated as a through bolt 2 in Fig. 3.

The bearing boxes 41 and 41' are fixed to the inner central portions of the frame pieces 1 and 1' and accommodate the bearings 4, 4' through which a shaft 5 is penetrated. Because the frame pieces 1 and 1' are coupled directly and firmly to each other, the precise positioning of the bearing boxes 41, 41' and the bearings 4, 4' is attained and errors in the positions of the centers of the bearings 4, 4' are minimized, and accordingly the precise support of the shaft 5 is attained. This helps the high speed rotation of the shaft 5 and reduces the vibration during the high speed rotation of the shaft 5.

The axial length of the housing formed by the frame pieces 1 and 1' decreases from the axis portion toward the circumferential portion. Accordingly, the housing has a swollen shape similar to the shape of an egg as illustrated in Fig. 3. This shape is advantageous because of the increased structural strength of the generator.

A core 3a of a stator 3 is fixed directly to the inside of the frame 1. The entire outside surface of the core 3a of the stator 3 contacts the inside surface of the frame 1. Heat generated in the stator core is conducted through said entire to the frame. This helps the efficient cooling of the stator. A stator winding 3b is wound around the stator core 3a.

The rotor core fingers 6 and 6' are offset circumferentially with respect to each other, as is well known to a person skilled in the art. The pole core of the rotor is located inside of the stator 3 and is fixed to the shaft 5. A rotor winding 7 is wound around the pole core of the rotor.

Cooling fans 8 and 8' are fixed to the side surfaces of the pole cores 6 and 6' of the rotor. The diameter of each of the cooling fans 8 and 8' is smaller than the inner diameter of the stator 3. Blades of the cooling fans 8 and 8' extend in outward directions. The number of the blades 8a of the cooling fan 8 is the same as the number of the rotor core fingers 6. The number of the blades of the cooling fan 8' is determined in accordance with the flow rate of the coolant air. The cooling fan 8 is of a mixed flow type having slant blades 8a so as to forward the coolant air to the rotor not only in the radial direction, but also in the axial direction so that the rotor core is sufficiently cooled by the coolant air (The blade 8a is slant in the direction of

axial length of said housing decreases from said central portions towards the circumference of the housing.

3. An alternate current generator as claimed in Claim 2, wherein the blades of said fans (8, 8') are sloped along each of said shrouds (1a, 1a').
4. An alternate current generator as claimed in Claim 1, further comprising a pulley (11) fixed to the end of said shaft (5) and having a plurality of grooves for a poly V belt in order to make the diameter of said pulley small, whereby the effective area of said intake windows (1b, 1b') which is not hindered by said pulley becomes wide so that said fan draws much air through said intake windows.
5. An alternate current generator as claimed in Claim 1, wherein said slip rings (9) are connected to said rotor winding (7) through conductors (10) arranged in slots (5a, 5a') in said shaft (5).

Revendications

1. Générateur de courant alternatif comprenant un arbre (5), des noyaux polaires (6, 6') d'un rotor fixé sur l'arbre, un enroulement de rotor (7), enroulé autour des noyaux polaires, un noyau de stator (3a) disposé autour du rotor, un enroulement de stator (3b), enroulé autour du noyau de stator, un logement renfermant le rotor et le stator et comprenant une paire d'éléments de châssis (1, 1'), une paire de ventilateurs (8, 8') fixés sur la surface latérale des noyaux polaires du rotor, dont au moins un de ces ventilateurs est de type centrifuge, une paire de paliers (4, 4') qui sont disposés dans la portion centrale des éléments de châssis (1, 1') et sur lesquels est monté l'arbre (5) de façon rotative, plusieurs fenêtres d'admission (1b, 1b') qui sont formées de façon contiguë aux paliers (4, 4') dans les éléments de châssis (1, 1') de sorte que l'air de refroidissement produit par les ventilateurs est aspiré à l'intérieur du logement par les fenêtres d'admission, plusieurs fenêtres d'échappement (1c, 1c') formées de façon contiguë au stator de sorte que l'air de refroidissement chauffé est évacué par les fenêtres d'échappement,

caractérisé en ce que

les éléments de châssis (1, 1') sont connectés directement l'un sur l'autre au niveau de leurs bords circulaires,

le noyau de stator (3a) est fixé directement sur l'un (1) des éléments de châssis, les paliers (4, 4') sont disposés de façon contiguë aux noyaux polaires respectifs, une paire de volutes (1a, 1a') est formée de façon contiguë aux ventilateurs (8, 8') et entre les fenêtres d'admission (1b, 1b') et les fenêtres d'échappement (1c, 1c'), des bagues collectrices (9) sont disposées sur l'arbre (5) à l'extérieur des éléments de châssis (1, 1'), et les éléments associés comprenant des balais (16a), des redresseurs (15) et une unité régulatrice de tension (17) sont situés à l'extérieur du logement formé par les éléments de châssis.

2. Un générateur de courant alternatif selon la revendication 1, dans lequel chacune des volutes (1a, 1a') s'étend obliquement de telle manière que la longueur axiale du logement diminue à partir des portions centrales en direction de la circonférence du logement.

3. Un générateur de courant alternatif selon la revendication 2, dans lequel les pales des ventilateurs (8, 8') sont inclinées le long de chacune des volutes (1a, 1a').

4. Générateur de courant alternatif selon la revendication 1, comprenant de plus une poulie (11) fixée sur une extrémité de l'arbre (5) et comportant plusieurs gorges pour un système de poly-courroie trapézoïdale de façon à réduire le diamètre de la poulie, la surface effective des fenêtres d'admission (1b, 1b') qui n'est pas gênée par la poulie peut être élargie de sorte que le ventilateur aspire un plus grand volume d'air par les fenêtres d'admission.

5. Générateur de courant alternatif selon la revendication 1, dans lequel les bagues collectrices (9) sont connectées à l'enroulement du rotor (7) par le conducteur (10) disposé dans les lentes (5a, 5a') dans l'arbre (5).

Patentansprüche

1. Wechselstromgenerator umfassend eine Welle (5), Polkerne (6, 6') eines Rotors, der an die Welle befestigt ist, eine Rotorwicklung (7), die um die Polkerne gewunden ist,

rotation.) The cooling fan 8' is of a centrifugal type.

The fresh coolant air is drawn through the intake windows 1b and 1b' formed adjacent to the bearing boxes 41 and 41' in the frame pieces 1 and 1'. The heated coolant air is exhausted through the exhaust windows 1c and 1c' formed adjacent to the stator 3 in the frame pieces 1 and 1'.

Slip rings 9 are connected to the rotor winding 7 through conductors 10, 10' arranged in slots 5a, 5a' in the shaft 5. The slip rings 9 are arranged on the shaft 5, adjacent to the position of the bearing 4' and outside of the frame pieces 1, 1'.

A pulley 11 having four grooves is fixed to one end of the shaft 5 by a screw nut 13 and a washer 14. Collars 12 and 12' are inserted between the rotor core 6 and the bearing 4 and between the bearing 4 and the pulley 11. The pulley 11 is driven by an engine through a poly V belt (not shown).

A diode fin 15 carrying diodes, brushes 16a supplying an excitation current to the rotor winding through the slip ring 9 and conductors 10, 10', brush holders 16, and a voltage regulator unit 17 of the hybrid integral circuit type (so-called the IC type) for controlling the field current of the generator are arranged outside of the frame pieces 1, 1' and are accommodated in a rear cover 19 which is fixed to the frame piece 1' by bolts 18. Only one of said bolts 18 is illustrated in Fig. 3. The rear cover 19 serves as a protective cover for the above described elements accommodated in the rear cover 19 outside of the frame pieces 1, 1'. Windows 19a and 19b are provided in the rear cover 19 for the cooling of the regulator 17 and the diode fin 15. Diodes 151, 152 and 153 are located in the recesses on the diode fin 15 (Fig. 2). The heat generated in the diodes is effectively dissipated in the coolant air through the diode fin.

An electrical connector 171 is provided adjacent to the regulator 17 to form an electrical connection to a storage battery and the like. Because all of the main static electrical elements, such as diodes, brushes, brush holders, a regulator and an electrical connector are arranged compactly outside of the frame pieces 1, 1' and in the space formed by the rear cover 19, only a small length of the conductors is required for the electrical connections among the main static electrical elements.

In operation, the coolant air drawn through the window 1b cools in sequence the bearing 4 and the stator winding 3b, and the resultant heated coolant air is exhausted through the window 1c. A portion of the coolant air drawn through the window 1b is pushed into the rotor structure through the gaps between the rotor core fingers 6, 6' to cool the rotor winding 7, passes through the stator winding 3b, and is exhausted through the window 1c'.

Simultaneously with the above described cool-

ing, the coolant air drawn through the windows 19a, 19b of the rear cover 19 cools either the regulator 17 or the diode fin 15, and is then drawn into the housing formed by the frame pieces 1 and 1' through the windows 1b'. The coolant air drawn into the housing cools in sequence the bearing 4' and the stator winding 3b and the resultant heated coolant air is exhausted through the window 1c'.

Claims

1. An alternate current generator comprising
 - a shaft (5),
 - pole cores (6, 6') of a rotor fixed to said shaft,
 - a rotor winding (7) wound around said pole cores,
 - a stator core (3a) arranged around said rotor,
 - a stator winding (3b) wound around said stator core,
 - a housing encasing said rotor and said stator and comprising a pair of frame pieces (1, 1'),
 - a pair of fans (8, 8') fixed to the side surface of said pole cores of said rotor, at least one of said fans being of a centrifugal type,
 - a pair of bearings (4, 4'), which are arranged in the central portion of the frame pieces (1, 1'), supporting rotatably said shaft (5),
 - a plurality of intake windows (1b, 1b') which are formed adjacent to said bearings (4, 4') in said frame pieces (1, 1'), so that coolant air, which is generated by said fans, is drawn inside of the housing through said intake windows,
 - a plurality of exhaust windows (1c, 1c') which are formed adjacent to said stator so that heated coolant air is exhausted through said exhaust windows,
 - characterized in that,
 - the frame pieces (1, 1') are coupled directly to each other at their circular edges,
 - said stator core (3a) is fixed directly to one (1) of said frame pieces,
 - the bearings (4, 4') are arranged adjacent to said respective pole cores,
 - a pair of shrouds (1a, 1a') is formed adjacent to said fans (8, 8') and between the intake windows (1b, 1b') and the exhaust windows (1c, 1c'),
 - slip rings (9) are arranged on the shaft (5) outside of the frame pieces (1, 1'), and
 - the associated elements including brushes (16a), rectifiers (15) and a voltage regulator unit (17) are located outside of said housing formed by said frame pieces.
2. An alternate current generator as claimed in Claim 1, wherein each of said shrouds (1a, 1a') extends obliquely in such a manner that the

einen Stator Kern (3a), der um den Rotor angeordnet ist,
eine Statorwicklung (3b), die um den Stator Kern gewunden ist,

ein Gehäuse, das den Rotor und den Stator umgibt und ein Paar Rahmenteile (1, 1') umfaßt,

ein paar Lüfterräder (8, 8'), die auf der Seitenfläche der Polkerne des Rotors befestigt sind, wobei wenigstens eines der Lüfterräder vom zentrifugalem Typ ist,

ein Paar Lager (4, 4'), die im mittigen Abschnitt der Rahmenteile (1, 1') angeordnet sind, um die Welle (5) drehbar zu halten,

eine Anzahl von Ansaugfenstern (1b, 1b'), die benachbart zu den Lagern (4, 4') in den Rahmenteilen (1, 1') ausgebildet sind, so daß Kühlluft, die durch die Lüfterräder erzeugt wird, in das Gehäuse durch die Ansaugfenster angesaugt wird,

eine Anzahl von Abluftfenstern (1c, 1c'), die benachbart zu dem Stator ausgebildet sind, so daß erwärmte Kühlluft durch die Abluftfenster ausgeblasen wird.

dadurch gekennzeichnet,

daß die Rahmenteile (1, 1') direkt miteinander an ihren ringförmigen Rändern verkuppelt sind, der Stator Kern (3a) direkt an eines (1) der Rahmenteile befestigt ist,

die Lager (4, 4') benachbart zu den jeweiligen Polkernen angeordnet sind,

ein Paar von Abschirmblechen (1a, 1a') benachbart zu den Lüfterrädern (8, 8') und zwischen den Ansaugfenstern (1b, 1b') und den Abluftfenstern (1c, 1c') ausgebildet ist,

Ringkontakte (9) auf der Welle (5) außerhalb der Rahmenteile (1, 1') angeordnet sind, und die zugehörigen Teile umfassend Bürsten (16a), Gleichrichter (15) und eine Spannungsregereinheit (17) außerhalb des Gehäuses angeordnet sind, das durch die Rahmenteile ausgebildet ist.

2. Wechselstromgenerator nach Anspruch 1, wobei sich jedes der Abschirmbleche (1a, 1a') schräg in einer Art und Weise erstreckt, daß die axiale Länge des Gehäuses von den mittigen Abschnitten in Richtung des Umfangs des Gehäuses abnimmt.

3. Wechselstromgenerator nach Anspruch 2, wobei die Schaufeln des Lüfterrades (8, 8') längs eines jeden Abschirmbleches (1a, 1a') abgeschrägt sind.

4. Wechselstromgenerator nach Anspruch 1, ferner umfassend eine Riemenscheibe (11), die an das Ende der

Welle (5) befestigt ist und eine Anzahl von Nuten für einen Riemen mit mehreren V-förmigen Vorsprüngen hat, um den Durchmesser der Riemenscheibe klein zu halten, wobei die Wirkungsfläche der Ansaugfenster (1b, 1b'), die nicht durch die Riemenscheibe behindert wird, groß wird, so daß das Lüfterrad viel Luft durch die Ansaugfenster ansaugt.

5. Wechselstromgenerator nach Anspruch 1, wobei die Kontaktringe (9) mit der Rotorwicklung (7) durch Leitort (10) verbunden sind, die in Schlitzen (5a, 5a') in der Welle (5) angeordnet sind.

Fig. 1

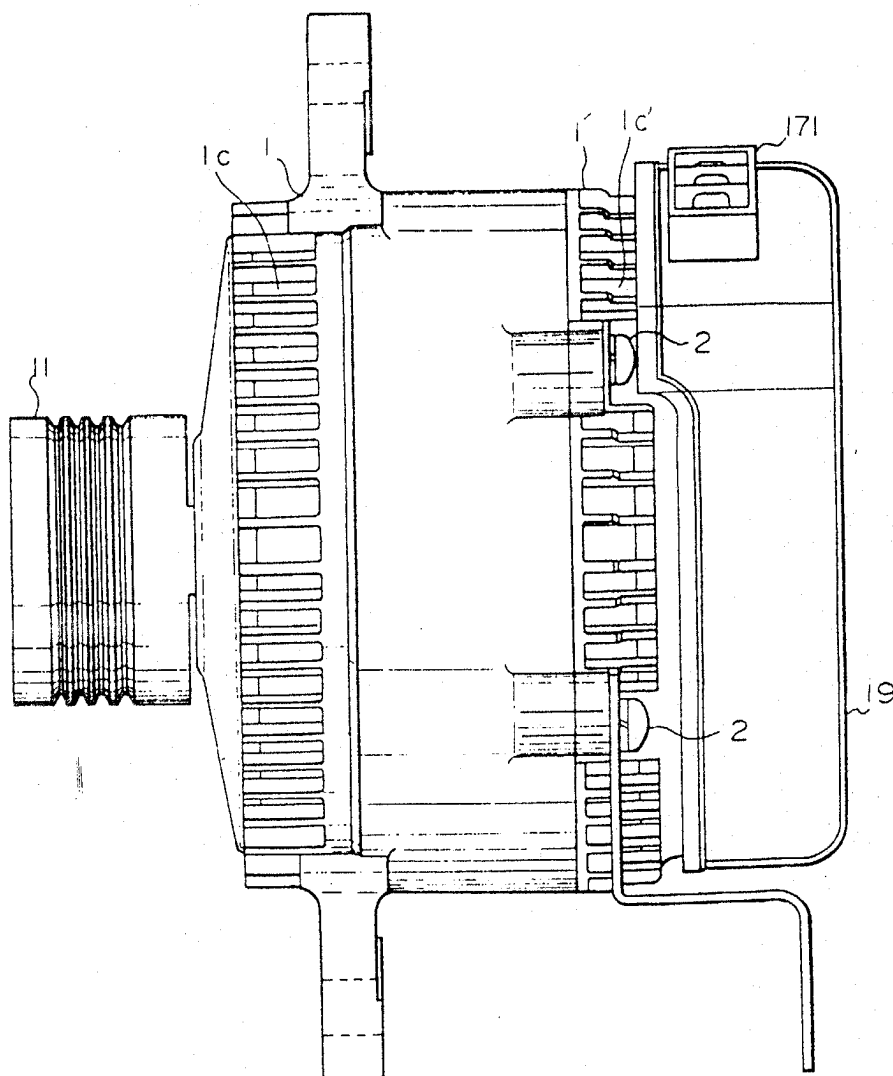


Fig. 2

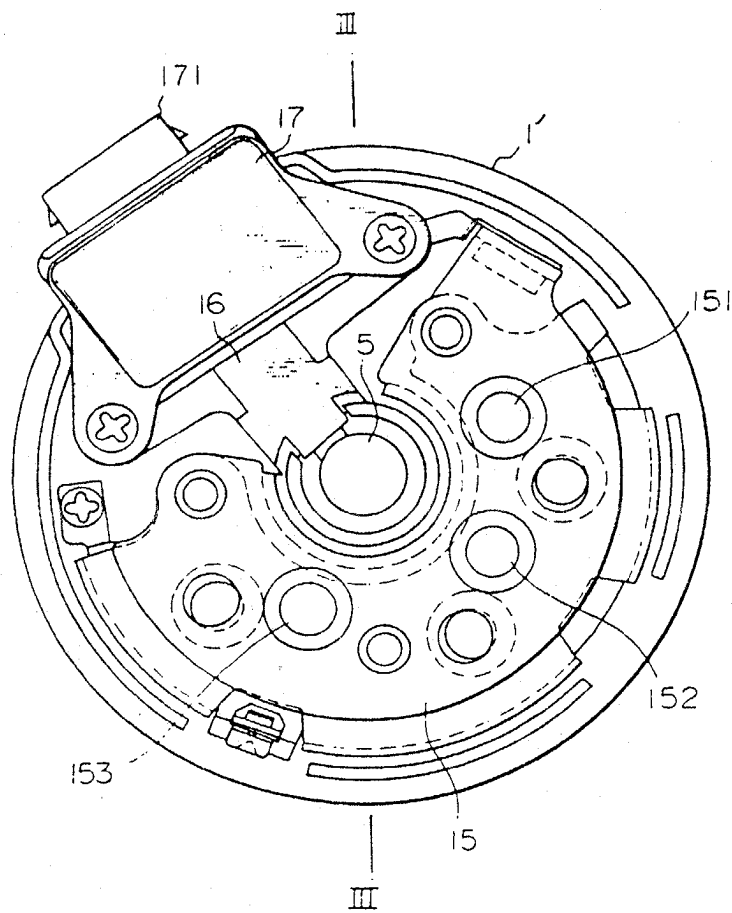


Fig. 3

